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ABSTRACT

The document is a catalog of behavioral objectives organized by units of instruction in drafting. Each of the 22 units contains an outline of the content, a goal statement, and general and specific objectives. The units were developed by teachers in summer workshops to provide: (1) a bank of objectives for task analyses and job descriptions; (2) a bank of test items for studies of program effectiveness; and (3) materials for use in a delivery system for objectives and a computer bank of test items, as in the pilot project Behavioral Objectives Organized in a System for Teachers (BOOST). (Author/AJ)

ED 094197

Vocational Education Evaluation Project

Behavioral Objectives for Selected Units In Drafting

Richard K. Hill William R. Williams
Editors

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Division of Vocational-Technical Education
College of Education
Virginia Polytechnic Institute and State University
Blacksburg, Virginia 24061

and

Division of Vocational Education and
Division of Educational Research and Statistics
State Department of Education
Richmond, Virginia 23216

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FOREWORD

The primary objective of the Vocational Education Evaluation Project is to develop a management information system for the planning and programming of vocational education. To facilitate the accomplishment of this objective, the work of the project has been divided into a macro-subsystem and a micro-subsystem. The macro-subsystem is primarily concerned with guidelines and systematic procedures at the state level, while the micro-subsystem is emphasizing the assessing, planning, and programming of individual vocational education programs in local schools.

Direct costs for this project were funded on a 90 percent reimbursement basis by the Division of Vocational Education, State Department of Education, Richmond, Virginia. These funds came from Part C of the Vocational Education Amendments of 1968. The remaining 10 percent of direct costs and all indirect costs were funded by the Research Division, Virginia Polytechnic Institute and State University. The Division of Educational Research and Statistics, State Department of Education, provided the data processing for the Vocational Education Reporting System.

Special gratitude is expressed to the Division of Vocational Education and the Division of Educational Research and Statistics, State Department of Education for their financial assistance and staff support.

The units contained in this catalog were developed for use in the micro-subsystem. These materials are the products of an effort to develop a means of assessing the effectiveness of local instructional programs.

This publication is one in a series of publications of the Vocational Education Evaluation Project. The intent of this series is to inform educators in Virginia, as well as the nation, of the project's work.

Dewey A. Adams, Director
Division of Vocational and
Technical Education
College of Education

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Bedford Educational Center
Bedford, Virginia

Billy J. Gilbert
Fieldale-Collinsville High School
Collinsville, Virginia

Welch B. Johnston
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Tazewell, Virginia

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George Mason Jr.-Sr. High School
Falls Church, Virginia

Dennis M. Sayers
Radford High School
Radford, Virginia

Thomas A. Stewart
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INTRODUCTION

WHAT IS IN THE CATALOG

This is a catalog of behavioral objectives organized by units of instruction in drafting. Each unit contains an outline of the content, a goal statement, and general and specific objectives.

HOW THE UNITS WERE DEVELOPED

These units were developed during summer workshops conducted on the campus of Virginia Polytechnic Institute and State University during the summers of 1972 and 1973. Drafting teachers from throughout the Commonwealth participated. They received instruction on how to develop these materials and then wrote them in workshops. During the workshop, their work was supervised by Dr. Richard Hill and Mr. Randy Williams. At the conclusion of the workshop, the materials were collected and edited by Mr. Williams.

WHY THE UNITS WERE DEVELOPED

The original intent in writing the units was three-fold: to provide a bank of objectives which could be related to task analyses and job descriptions, to provide a bank of test items which could be used in state-wide studies of program effectiveness, and to develop materials which could be used in BOOST (Behavioral Objectives Organized in a System for Teachers). There is an explanation of BOOST starting on page 6.

HOW TO USE THE CATALOG

How These Objectives Are Written And Organized

A set of behavioral objectives must be comprehensive and specific. It must be comprehensive for planning purposes because the exclusion of any objective might be critical. (For example, if a unit is written on good grooming and all the objectives that relate to understanding why good grooming is important are left off, it might as well not have been started. Surely, someone who understands "how" but not "why" is unlikely to exhibit the behaviors desired when he is no longer restrained by the testing situation.) The objectives must be specific for evaluation purposes because reliable tests cannot be developed if the objectives which determine the questions to be constructed are subject to varying interpretations.

The way objectives typically are written is to attempt to develop one comprehensive set of specific objectives. This approach would yield a satisfactory solution if, in fact, it were possible to do. Since it usually is not, when they are asked to do it, most teachers encounter great frustration. Their usual response is to develop a long list of objectives which require recall of the content to be presented, and little more. Of course, if they were asked if that list of objectives reflected their true intent, they would respond negatively. However, the construction of this first list takes so long that they usually stop there, having little time or desire to continue. This unsatisfactory situation need not continue. This current approach of writing objectives ignores the fact that there really is no need for a set of comprehensive objectives to be specific, nor for a set of specific objectives to be comprehensive. This will be explained in greater detail.

The objectives must be comprehensive for planning purposes. But teachers can plan their instruction at least as well from more general statements as they can from specific ones, and frequently even better. For planning purposes,

it should be permissible to use words such as "understand," "appreciate" and "comprehend." So long as the objectives are written so that teachers can communicate with each other with reasonable clarity, further specificity is not required.

The purpose of writing specific objectives is to have a starting point for the development of test questions. But a test is never comprehensive; therefore, there is no need for the specific objectives to be comprehensive either. They only must be representative.

This alternative approach to writing objectives was used in the development of this catalog. Each unit contains one set of objectives which is comprehensive and clear, but not specific, and then another set of objectives which is specific and representative, but not comprehensive. With this approach, the former set of objectives (called general objectives) is written first. The latter set is written by taking each general objective, and writing five to eight specific objectives for each. The specific objectives should cover as many different aspects of the general objective as possible. Their main purpose is to help define and add clarity to the general objective.

The reason for putting limits on the number of specific objectives to be written for each general objective is to help insure representativeness. It is easy to succumb to the temptation of writing a few specific objectives for some general objectives, and writing dozens of specific objectives for a general objective that covers a broad content base, but this practice leads to the development of a test which is unbalanced.

This method recognizes that teachers and evaluators have different reasons for writing objectives. (It is assumed here that the teacher and evaluator are two different people. Of course, it most commonly happens that

the teacher changes hats and becomes his own evaluator, but we will make a distinction between these two for purposes of discussion.) A teacher needs to feel that his list of objectives is complete, because it may well be that the worth of a unit is lost if one major component is missing. An evaluator does not need such a complete list, because the measures he uses are always samples anyway. He needs only a representative sample.

HOW TO DEVELOP YOUR OWN UNIT

The first point to be emphasized is that the units are not written as someone's suggestion as to how you should teach your students. The material is organized into units simply because it will be much easier for you to locate the objectives you want to use. Therefore, do not consider this book to be some official guide which requires you to teach certain objectives when teaching the units listed herein.

The second point to be remembered is that you should use the general objectives to plan your teaching. Use the specific objectives only to help clarify what is meant by the general objective. Keep in mind that only a sample of specific objectives is given for each general objective. Do not consider this to be a comprehensive set of specific objectives. The philosophy under which these were written precludes the possibility of generating such a set.

To use this catalog in teaching, you might proceed in the following way:

1. Jot down a title for the unit you want to teach. Think about what your students will be doing as a worker with the material you are going to present in class. If you can write a work-oriented goal statement like the ones in this catalog, go ahead and do so.

2. Turn to the table of contents of this catalog. Note any titles of units which might have objectives related to your proposed unit.

3. Read those units, and then write down the general objectives that you can glean from them that are appropriate for your unit. You may be able to find objectives from several units that you can use in the one you are writing.

4. Review the set of general objectives to make sure they are complete. Remember, the general objectives must be comprehensive. Ask yourself if you have ever had a student who could succeed on all the objectives you have listed, but still failed on the job. If you can figure out why he failed, that should give you an idea for another objective. For example, suppose you are writing a drafting unit dealing with welding. Perhaps you once had a student who could identify all terms, processes and symbols, yet his employer was dissatisfied because his drawings were not realistic for on-the-job situations. With this information in mind, you should add a general objective that reads something like, "The student will understand the limitations imposed by welding equipment design." Of course, now you must help to define what you mean in this general objective by writing a sample of specific objectives which cover it as representatively as possible.

5. When you are satisfied that your general objectives are complete, (usually somewhere between 5 and 10 general objectives) develop your content to cover them.

6. Teach the unit.

7. When ready to develop a test, go back to the specific objectives listed under each general objective you decided to use. Develop a test item which will measure each one. For example, in the unit titled "Structural Drawing," the first specific objective under general objective I is:

I.A.--Specifically the student will be able to identify the main structural parts of a building, bridge, tank, or tower.

One way to test whether or not the student can actually do this would be with the following test question:

1. The main structural member that frames from column to column providing end support for other beams or joists is called:

    1. Lintels
    2. Columns
    3. Girders
    4. Trusses
    5. Gussets

That should be all there is to doing a whole unit. Of course, there is no need for this unit to be taught to a whole class. If you individualize your instruction, it might well be developed for only one student. But whether you do it for one student or for thirty, the time savings should be substantial, while you still have a unit which is yours alone, and written with your students and their needs in mind.

BOOST

BOOST (Behavioral Objectives Organized in a System for Teachers) is a delivery system for objectives, such as those contained in this catalog, and a computer bank of test items associated with the objectives. Rather than having teachers develop their own tests as explained above, the tests are generated for them. In the computer bank, there are several test items written to measure each general objective. A test is developed by selecting items from the pool which are related to any given set of objectives.

A pilot project of BOOST is being conducted with stenographic block teachers of business education in Hampton, Richmond, and Prince William County during the spring of 1974. The extension of BOOST to additional areas in vocational education is dependent upon the availability of funds.

Unit: INTRODUCTION TO DRAFTING

Outline of Unit

I. History of the Drafting Occupation

A. Language of drafting
B. Recent developments in drafting

II. Course Content

A. The specialized areas
B. How to use instructional material

III. Need and Opportunity in Drafting

A. Nature of the work
B. Employment outlook

Goal Statement

The student will gain an appreciation of the field of drafting in the world of work. He will understand that there are many related areas in which drafting skills are essential.

General and Specific Objectives

I. The student will understand the definition of drafting. Specifically the student will be able to:

A. select the labels applied to different types of drawings.
B. identify the parts of a drawing.

II. The student will understand the history of drafting. Specifically the student will be able to:

A. describe historic evidence of drafting.
B. describe the prime use of drawings.
C. describe the use of a master drawing.

III. The student will understand the special areas of drafting. Specifically the student will be able to:

A. select the type of drawing most used in each specialized area.
B. select the technique most frequently used in each specialized area.

IV. The student will understand the related areas of drafting. Specifically the student will be able to:

A. select occupations which use drafting skills directly.
B. select occupations which use drafting skills indirectly.

V. The student will appreciate which drafting area is most needed in his community. Specifically the student will be able to:

A. discover job opportunities in the field of drafting.
B. discover job opportunities in other fields which require a knowledge of drafting.

Unit: DRAFTING FUNDAMENTALS

Outline of Unit

I. Basic Equipment, Instruments and Supplies

II. Use of Equipment and Supplies

III. Equipment Maintenance

IV. Systematic Location of Equipment and Supplies

V. Proper Line Technique

VI. Fundamentals of Drawing Layout

Goal Statement

The draftsman properly uses, maintains and locates instruments, equipment and supplies. He applies the basic fundamentals in completing acceptable drawings.

General and Specific Objectives

I. The student will use all basic drafting instruments. Specifically the student will be able to:

A. match the name of the basic instrument with its use.
B. select instruments he will need to complete a job.
C. recognize the advantages of the parallel bar over the drafting machine in drawing long horizontal lines.
D. recognize the advantages of the drafting machine over the T-square in drawing inclined lines.
E. measure specific lengths with the mechanical draftsman's scale.
F. measure specific lengths with the architectural scale.
G. measure specific lengths with the engineer's scale.
H. recognize the proper combinations of the triangle summary when using a T-square, a 30°-60° triangle, and a 45° triangle.
I. recognize the purposes of the Ames lettering guide.

II. The student will use all basic drafting equipment. Specifically the student will be able to:

A. recognize the function of each basic piece of equipment.
B. recognize the most commonly used reproduction process used in industry to reproduce drawings.
C. recognize the principles involved in "blue line" reproduction.

III. The student will select supplies. Specifically the student will be able to:

A. define supplies.
B. recognize the two most commonly used systems of drawing paper sizes.
C. given a specific drafting fundamental, select the correct grade of lead that should be used.

D. recognize the types of materials on which the drawings are done.
E. decide whether to increase or decrease the speed of a blueline reproduction machine to obtain a darker or lighter print.
F. recognize different reproduction processes.
G. appreciate the use of standard paper sizes.

IV. The student will recognize the importance of drafting room maintenance. Specifically the student will be able to:

A. recognize the consequences of failing to keep drawing instruments clean.
B. recognize a need to keep the reproduction equipment in proper working order.
C. recognize what to do in situations where faulty operation of equipment might damage a drawing.

V. The student will demonstrate an appreciation for shop safety. Specifically the student will be able to:

A. list accidents that might occur in a drafting room.
B. recognize accident avoidance measures.
C. recognize the consequences of working in a poorly lighted drafting room.
D. state what should be done if a draftsman has an accident.
E. state what should be done if an epileptic has a seizure.

VI. The student will recognize systematic drafting room organization. Specifically the student will be able to:

A. recognize the importance of proper replacement of items commonly used by all draftsmen in the drafting room.
B. explain the importance of a periodic inventory of drafting supplies.
C. recognize the importance of a systematic means of filing drawings.

VII. The student will demonstrate an appreciation for application of drafting fundamentals. Specifically the student will be able to:

A. recognize the efficiency gained by proper application of fundamentals.
B. demonstrate the proper method of aligning a drawing with equipment.
C. recognize the advantages of a systematic layout of views.
D. match each of the alphabet of lines with its fundamental.
E. demonstrate how to hold a pencil when drawing lines.
F. demonstrate the proper method for making erasures.

Unit: GEOMETRIC CONSTRUCTION

Outline of Unit

I. Lines

- A. Parallel
- B. Perpendicular
- C. Bisectors
- D. Equal segments
- E. Divide equal-unequal parts

II. Angles

- A. Bisecting
- B. Transferring

III. Plane Figures

- A. Triangles
- B. Hexagons
- C. Octagons
- D. Pentagons
- E. Other polygons

IV. Solid Figures

- A. Rectangular solids
- B. Cones
- C. Spheres

V. Circles and Arcs

- A. Tangents
- B. Arc Measurements
- C. Ogee curves
- D. Ellipse Construction

Goal Statement

The draftsman draws straight lines, arcs, circles and ellipses. He utilizes perpendiculars, parallels, as well as other various types of angle and must draw polygons and tangents while applying these fundamentals to the various drawing problems encountered in this field. All work is done in a manner which will meet or exceed job entry level requirements.

General and Specific Objectives

I. The student will apply correct terminology to each geometrical shape. Specifically the student will be able to:

A. identify various geometrical shapes.
B. describe the characteristics of each shape.
C. list the different parts of a circle.
D. list the different types of angles.
E. draw a hexagon.
F. draw an octagon.
G. draw different quadrilaterals.

II. The student will appreciate the relationship between mathematics and geometric construction. Specifically the student will be able to:

A. draw the proof of the Pythagorean Theorem.
B. figure the area of a circle mathematically and check it by employing the draftsman's technique.
C. divide a line into a number of equal parts.
D. divide any line into unequal parts.

III. The student will recognize geometrical construction on a typical drawing. Specifically the student will be able to:

A. list the different types of construction on a given drawing.
B. relate each type of construction to the one it is tangent to.
C. find tangent points.
D. find center points.

IV. The student will understand and apply the fundamental principles of geometric construction. Specifically the student will be able to:

A. bisect any angle.
B. bisect a straight line.
C. draw perpendicular lines.
D. draw parallel lines.
E. draw simple one-view drawings containing different geometric constructions.
F. construct an equilateral triangle.
G. draw an arc or circle through three points not on a circle.
H. construct an ellipse by any given method.

V. The student will recognize the importance of accuracy in geometric construction. Specifically the student will be able to:

A. list reasons why accuracy is important.
B. identify inaccurate areas of a given drawing.

Unit: LETTERING AND MEDIA

Outline of Unit

I. Orientation to Drafting

A. History and evolution
B. Today's uses

II. Hand and Mechanical Lettering

A. Styles
B. Techniques
C. Size and proportion
D. Spacing
E. Devices

III. Reproduction Processes

A. Machines
B. Media

Goal Statement

The draftsman uses the appropriate styles of lettering to meet or exceed job entry level requirements. Proper technique must be utilized in all lettering and media selection as required by the employer.

General and Specific Objectives

I. The student will develop an appreciation of the history and development of lettering. Specifically the student will be able to:

A. identify given examples of symbols by matching them with their culture of origin.
B. understand and identify developments in lettering.

II. The student will recognize legible and uniform hand lettering. Specifically the student will be able to:

A. identify uniformity in lettering.
B. differentiate between correct and incorrect spacing.
C. understand the importance of legibility.
D. apply good hand lettering.

III. The student will apply lettering in related areas of drafting. Specifically the student will be able to:

A. choose an appropriate style for lettering jobs.
B. appreciate lettering as a professional skill.
C. apply different lettering styles.

IV. The student will use a variety of lettering devices. Specifically the student will be able to:

A. use the template lettering device.
B. use the Leroy lettering device.
C. use the rapid-o-graph lettering device.

V. The student will apply a variety of lettering techniques. Specifically the student will be able to:

A. differentiate between types of ink.
B. differentiate between brush and other techniques.
C. appreciate the proper use and care of pens.
D. understand the use of shading as a lettering technique.
E. use ink in lettering.

VI. The student will use a variety of media in the drafting area. Specifically the student will be able to:

A. understand the types of graphic representations.
B. understand the media in presentations.
C. understand the use of commercially produced transfer materials.
D. understand the use of transparencies and overlays.

VII. The student will utilize reproduction processes. Specifically the student will be able to:

A. understand the current business trends in drawing storage and retrieval.
B. understand the different reproduction processes.
C. understand the use of the reproduction process as the tool of the draftsman.

Unit: ORTHOGRAPHIC PROJECTION

Outline of Unit

I. Basic Concepts of Orthographic Projection

- A. Selecting primary views
- B. Arranging views on the page
- C. Projecting surfaces and edges
- D. Inclined, cylindrical surfaces

II. Alphabet of Lines

- A. Hidden surfaces and edges
- B. Construction lines

III. Projections

- A. Planes of projection
- B. Multiple-view drawings
- C. Simple three-view drawings
- D. Semi-complex multiple view drawings
- E. Projection of curved surfaces

IV. Sketching

- A. Importance of freehand sketching
- B. Use of materials
- C. Types of sketching

V. Partial Views

- A. When to use partial views
- B. Left-hand and right-hand drawings

Goal Statement

The student will be able to apply the basic concepts of orthographic projection. The student should be able to incorporate all other phases of drafting within the guidelines of orthographic projection.

General and Specific Objectives

I. The student will appreciate the value of orthographic projection. Specifically the student will be able to:

- A. recognize three specific reasons for using orthographic projection.
- B. given a three-view orthographic of five respective objects, identify the three-view orthographic having a view drawn incorrectly.
- C. identify valuable uses of orthographic projection.

II. The student will understand the basic theory of orthographic projection. Specifically the student will be able to:

A. determine the best description of orthographic projection.
B. select the three primary views in their proper locations.
C. select the correct arrangement of the six principal views.
D. given three primary views, choose the view in which the three basic dimensions are represented correctly.
E. given five pictorials, choose the pictorial with the oblique plane present.
F. given a pictorial, indicate the true length projection lines.
G. given a specific object, identify the various types of lines.
H. define the purpose of opposite hand drawings.

III. The student will apply the principles of orthographic projection through communication with the manufacturer. Specifically the student will be able to:

A. given a pictorial of an object, draw the minimum number of views required to show the exact shape.
B. given a two-view orthographic, be able to determine the third view.
C. given a pictorial, select the front view.

IV. The student will demonstrate the ability to produce orthographic drawings with regard to economic factors. Specifically the student will be able to:

A. recognize time-saving procedures.
B. identify sketching equipment.
C. list the steps in producing a freehand sketch in proper sequence.

Unit: DIMENSIONS AND NOTES

Outline of Unit

I. Drawing to Scale

II. Dimension Lines

III. Placement of Dimensions

IV. System of Dimensioning

V. Notes and Terms

VI. Limits, Tolerances and Fit

Goal Statement

Drafting is communication. Basic to this work is dimensioning and noting that will properly supplement the graphics. Skill and methods concerning notes and dimensions must be learned and practiced by the student.

General and Specific Objectives

I. The student will shape and size description. Specifically the student will be able to:

   A. select the necessary views for a three-view drawing.
   B. sketch an object in isometric view for study.
   C. sketch an object in its geometric breakdown.

II. The student will determine the scale of a drawing for best presentation. Specifically the student will be able to:

   A. choose the proper scale to draw a three-view object.
   B. select the paper size for a drawing problem.
   C. identify the types of scales (architect's scale, engineer's scale, mechanical draftsman's scale, and decimal scale).

III. The student will apply the alphabet of lines. Specifically the student will be able to:

   A. demonstrate by drawing the three basic line widths. (Thick, medium, and thin)
   B. choose proper lead grade and lead point to control line width.
   C. adjust a ruling pen to demonstrate line weight in ink.
   D. given a three-view drawing, identify dimension, extension, and center lines.
   E. given a three-view drawing, identify notes and leaders according to ASA standards.

IV. The student will apply the standards of dimensions. Specifically the student will be able to:

A. differentiate between aligned and unidirectional systems of dimensioning.
B. given a three-view drawing, apply the proper dimensions.
C. given a "staged" three-view drawing, identify the superfluous dimensions.
D. given a specific drawing list's notes relating to keyways, holes, and fasteners, apply these notes in the proper systematic manner.

V. The student will perform the proper placement of dimensions. Specifically the student will be able to:

A. apply dimensions in proper order.
B. demonstrate proper technique in crossing dimension, center, extension, and object lines.
C. given fractional dimensions, letter correctly.
D. given tolerances on precise fit points, letter correctly.

VI. The student will understand the terms and notes necessary for clear communication from design to product. Specifically the student will be able to:

A. apply notes concerning fillets and rounds.
B. apply finish marks.
C. note drill-bore size and depth.
D. note core and ream size.
E. use countersink note.
F. note fastening device data.
G. note surface treatment.

VII. The student will comprehend limits and tolerances necessary for standardization and proper fit. Specifically the student will be able to:

A. select fit for mating parts.
B. use charts for information for clearances to be noted.
C. use charts for selecting finishes on surfaces to be noted.

Unit: SHOP PROCESS AND MATERIALS

Outline of Unit

I. Manufacturing Processes

A. Casting
B. Machining
C. Welding
D. Forming
E. Forging

II. Pattern and Machine Drawings

A. Pattern construction
B. Machine operation
C. Template design
D. Tool and die

III. Shop Measurements

A. Scales
B. Calipers
C. Gauges
D. Micrometer
E. Square
F. Meters

IV. Nomenclature and Terms

A. Jigs and fixtures
B. Heat treatment
C. Automation
D. Glossary of terms

Goal Statement

The draftsman transfers design concepts and procedures to working drawings. The methods of manufacturing and quality control designed into a product must be conveyed from the design engineer to production line personnel.

General and Specific Objectives

I. The student will understand the concepts of manufacturing methods used in mass production. Specifically the student will be able to:

A. select the correct materials for a given manufacturing process.
B. categorize an item from a list of processes as being a production or an assembly process.
C. identify various means of fabrication.
D. identify tools and equipment used in production.
E. select proper jigs and fixtures to be used in assembly line processes.

II. The student will appreciate the need for quality control from the origin of design through production. Specifically the student will be able to:

A. distinguish between non-control and tolerance dimensions on a given set of working plans.
B. recognize the various manufacturing methods necessary to produce acceptable tolerances.
C. identify inaccurate specifications from a given set of specifications.

III. The student will relate time and economy to working drawings. Specifically the student will be able to:

A. indicate proper procedures to facilitate the fastest method of processing.
B. recognize time saving methods of detailing plans without sacrificing quality.
C. identify errors that cause production "hold up" problems.

IV. The student will translate terminology and symbols for personnel performing the actual manufacturing processes. Specifically the student will be able to:

A. list five terms related to the fabrication process.
B. match correct terms and symbols with a given set of materials.
C. identify manufacturing processes capable of producing a round hole.
D. relate various finishes on machined parts to methods of the manufacturing process.
E. list four terms that would be used to show the sequence of assembly.

V. The student will recognize the need for specifying materials and processes in order to obtain desired products. Specifically the student will be able to:

A. relate surface control finishes to complexity of production.
B. identify four materials that can be machined by mass production processes.
C. identify three processes that produce material hardness in the finished product while retaining the desired quality of production.
D. identify characteristics of metals as they relate to the various manufacturing processes.

Unit: WELDING

Outline of Unit

I. Terminology

II. Processes

A. Gas welding
B. Electric arc welding
C. Electric-resistance welding

III. Symbols

A Types of welds
B. Joints

Goal Statement

The draftsman indicates the type of joint and the location and size of the welds.

General and Specific Objectives

I. The student will apply correct terminology to the different welding processes. Specifically the student will be able to:

A. identify the welding process.
B. identify the different welding symbols.
C. identify the elements of the welding symbols.

II. The student will develop a working knowledge of welding systems and methods. Specifically the student will be able to:

A. define seam welding.
B. define inert gas welding.
C. define pulsation welding.
D. define electrical welding.
E. define oxyacetylene welding.
F. define brazing.

III. The student will be able to produce working drawings from design sketches or layouts. Specifically the student will be able to:

A. draw correct welding symbols.
B. place the symbols in the proper places.
C. give the correct dimensions of the symbols.
D. specify field or shop welds.
E. give specifications for design sketches or layouts.
F. draw the basic joints.
G. draw details from general layouts.

Unit: SECTIONS AND CONVENTIONS

Outline of Unit

I. Purpose of Sections

II. Types of Sections

III. Drawing Practices for Sectional Views

IV. Conventional Practices

Goal Statement

The draftsman visualizes the internal construction of an object and then draws the proper views to describe this object. He applies the correct conventional section technique to all drawings produced.

General and Specific Objectives

I. The student will understand the basic theory of sections. Specifically the student will be able to:

   A. list reasons for drawing sections.
   B. identify full sections.
   C. recognize the purpose of section lining.
   D. relate sections as a part of orthographic projection.
   E. recognize the purpose of a cutting-plane line.
   F. identify a half section.
   G. identify an offset section.
   H. identify a revolved section.
   I. identify a broken-out section.
   J. identify a removed section.
   K. identify an assembly section.
   L. identify an aligned section.

II. The student will develop a working knowledge of section drawings. Specifically the student will be able to:

   A. select the applicable section lining for a specific object to be drawn.
   B. differentiate between types of cutting plane lines.
   C. explain the omission of the cutting plane.
   D. omit detail in a section without seriously affecting readability.
   E. lay out a drawing as a projection from a given sectional view.
   F. explain a broken-out section over a full section.
   G. differentiate between the cutting-plane line and other lines of the alphabet of lines.

III. The student will apply the standard technique to sections. Specifically the student will be able to:

A. recognize the correct section lining applied.
B. list reasons for rules concerning section lining to adjacent parts in section.
C. explain omission of hidden lines.
D. given a drawing with cutting plane shown, display proper view indicated.
E. isolate the view that demonstrates the rules for visible, hidden, and center lines on sections.
F. recognize internal machine operations in sectional views.

IV. The student will demonstrate the ability to produce sectional views with regard to economic factors. Specifically the student will be able to:

A. omit detail in a given section that might cause ambiguity.
B. identify the section as the most economic way to solve a practical problem.
C. draw a half section when the object has identical features.

V. The student will recognize the variations in sectioning techniques to solve specific problems. Specifically the student will be able to:

A. omit sectional lining on standard parts that have no internal features.
B. recognize the advantages of one type section over the others for a specific solution.
C. apply breaks to a drawing.
D. locate the cutting plane to give the desired section.
E. omit sectional lining on ribs and spokes to prevent a false impression of thickness or solidity.
F. recognize the advantages of revolving a feature to improve clearness and understanding.

Unit: AUXILIARY VIEWS

Outline of Unit

I. Auxiliary Planes

- A. Section of a view
- B. Position of reference plane
- C. Classification of reference plane
- D. Noting reference plane

II. Types of Auxiliary Views

- A. Primary
- B. Partial
- C. Symmetrical
- D. Unsymmetrical
- E. Double

III. Revolutions

- A. Types of revolutions
- B. True length of line by revolutions
- C. True shape of plane

Goal Statement

The draftsman indicates the true shape of inclined and oblique surfaces of an object through the use of auxiliary views to effectively communicate with the manufacturer. The draftsman must be able to choose the type and placement of the auxiliary required to describe the object.

General and Specific Objectives

I. The student will appreciate the value of auxiliary views. Specifically the student will be able to:

- A. select the best reason for choosing an auxiliary view.
- B. determine when auxiliary views are needed.
- C. select the best definition of an auxiliary view.

II. The student will understand the basic theory of auxiliary views. Specifically the student will be able to:

- A. select the best definition of a secondary auxiliary.
- B. select the statement which best describes a primary auxiliary.
- C. select the statement which best describes a reference line.

III. The student will apply the principles of primary and secondary auxiliary views. Specifically the student will be able to:

A. choose the auxiliary which best describes a given pictorial.
B. choose or identify a primary auxiliary.
C. identify a secondary auxiliary.

IV. The student will demonstrate the ability to produce auxiliaries with regard to economic factors. Specifically the student will be able to:

A. choose the best auxiliary to describe an object.
B. select the best orthographic representation of an object requiring an auxiliary view.

Unit: THREADS AND FASTENERS

Outline of Unit

I. Terminology

II. Thread Form

III. Thread Fit

IV. Tapered Threads

V. Types of Fasteners

Goal Statement

A draftsman must be able to communicate using the proper terminology pertaining to t' read form characteristics. He must determine when it is necessary to use left-hand threads as opposed to the standard right-hand threads. He must realize that multiple threads have specific job uses and some threads require greater precision than others. A good draftsman must use this knowledge of threads and fasteners to select and note the many fastening devices available on today's market.

General and Specific Objectives

I. The student will understand how to communicate on paper and verbally use proper descriptive thread terminology. Specifically the student will be able to:

   A. define thread nomenclature.
   B. figure thread pitch.
   C. differentiate between the forms of threads.
   D. select threaded forms according to usefulness.

II. The student will understand the principle of threads in order to select right-hand or left-hand threads along with single and multiple threads. Specifically the student will be able to:

   A. describe the movement of right-hand threads.
   B. describe the movement of left-hand threads.
   C. explain single threads.
   D. explain double threads.
   E. explain triple threads.

III. The student will recognize and select suited threads and be able to draw these, properly noted and detailed. Specifically the student will be able to:

   A. Select threads from standard charts.
   B. determine the best way to draw the threads.
   C. draw sections and elevations.
   D. add notes to complete the details.
   E. draw schematic and simplified threads.

IV. The student will understand how to select materials from the market, taking into consideration job cost, availability, strength, and time of installation. Specifically the student will be able to:

A. select threads according to fit.
B. select according to cost of materials.
C. use charts regarding clearances.
D. select fasteners from catalogues.
E. detail fasteners from specification sheets for parts fabrication.

Unit: WORKING DRAWINGS

Outline of Unit

I. Purpose of Working Drawings

II. Types of Working Drawings

III. Standard Conventions

IV. Types of Assembly Drawings

V. Checking the Drawing

Goal Statement

The draftsman applies fundamental drafting skills and standard drawing conventions to represent an object in the form of details, assemblies, and written descriptions to aid in its production and/or construction.

General and Specific Objectives

I. The student will understand the use of working drawings in the manufacturing process. Specifically the student will be able to:

   A. explain the meaning of the term "ream in assembly."
   B. list 3 types of workers who would always use the same working drawing in completing a job.
   C. determine what information on a working drawing is needed by the pattern maker.
   D. identify the definition of a working drawing.
   E. differentiate between a "tabular" drawing and a "standard" drawing.
   F. determine what information is needed by the machinist.

II. The student will know the basic types of assembly drawings. Specifically the student will be able to:

   A. differentiate between a detail assembly and a design assembly.
   B. differentiate between an outline assembly and a general assembly.
   C. select the proper scale for drawing a design assembly.
   D. identify the purpose of a design assembly.
   E. differentiate between a detail drawing and an assembly drawing.
   F. identify the purpose of an outline assembly.
   G. identify another name for unit assembly.
   H. identify the purpose of a diagram assembly.

III. The student will apply the standard conventions in representing details and sections. Specifically the student will be able to:

A. explain how thin parts are indicated in section on assembly drawings.
B. identify the American standard symbol for section lining steel.
C. identify the type of line used to represent repeated features on a drawing.
D. select the parts necessary to be sectioned in a full section assembly drawing.
E. choose the proper section lining directions in a group of sectioned adjacent parts.
F. determine the correct size of a balloon.
G. explain the meaning of the term "local note."
H. identify the purpose of "ballooning" the parts.
I. lay out details in proper order.

IV. The student will be able to construct a bill of materials. Specifically the student will be able to:

A. select the proper location of a bill of materials on a drawing.
B. identify what information is contained in the bill of materials.
C. explain the purpose of the bill of materials.
D. represent standard parts properly.
E. explain how the items in the bill of materials are cross-referenced with the detail and assembly drawings.
F. select the proper size of lettering for the parts list.
G. choose proper line spacings.
H. select the proper type of lines.

V. The student will know how to complete a title block. Specifically the student will be able to:

A. select the proper location of the drawing number on the drawing sheet.
B. select the proper location of the title block on a drawing sheet.
C. explain the importance of assigning drawing numbers to a drawing.
D. explain how drawing sizes are indicated on a drawing.
E. list the three persons whose signatures usually appear on a working drawing.
F. decide how to designate the scale of a drawing in the title block.
G. identify what information is to be included in the title block.

VI. The student will appreciate the importance of checking his drawing. Specifically the student will be able to:

A. explain the meaning of the term "soundness of design."
B. check mating dimensions for proper coordination.
C. explain the problem of assigning the wrong drawing number to a drawing.
D. check for clearances on mating parts.
E. select the proper views to represent an object.
F. explain the importance of a good drafting technique.

VII. The student will apply standard revision practices. Specifically the student will be able to:

A. select the proper location of a revision block.
B. identify what information is contained in the revision block.
C. label revision changes properly.
D. select the proper size lettering.
E. explain who is responsible for recording drawing changes.
F. choose proper line spacings.
G. identify what is done with drawings requiring extensive drawing changes.
H. identify how drawing revisions are usually located.

Unit: PICTORIAL DRAWING

Outline of Unit

I. Orientation to Drafting

II. Techniques

- A. Axonometric
- B. Perspective
- C. Oblique

III. Production Illustrations

- A. Catalog illustrations
- B. Architectural renderings
- C. Patent drawings

Goal Statement

The draftsman uses the appropriate pictorial technique to convey all information required by the problem. The draftsman must apply adequate knowledge of pictorial techniques to the job requirements.

General and Specific Objectives

I. The student will appreciate the variety of pictorial techniques. Specifically the student will be able to:

- A. summarize the history of pictorial drawings.
- B. explain the use of pictorial drawings in public education projects.
- C. explain the use of pictorial drawings in the area of service and repair.
- D. explain the use of pictorial drawings as an aid to the designer.
- E. explain the use of pictorial drawings as a training device.

II. The student will understand and apply axonometric styles of drawing. Specifically the student will be able to:

- A. define and differentiate between axonometric projections and drawings.
- B. explain the use of isometric axes.
- C. explain the application of isometric measurement to non-isometric lines.
- D. explain the isometric square method for an ellipse.
- E. select the proper dimensioning method for isometric drawings.
- F. differentiate between isometric and dimetric projections.

III. The student will understand and apply the oblique technique. Specifically the student will be able to:

A. differentiate among a cabinet drawing, general oblique, and cavalier projection techniques.
B. explain the proper procedure for general oblique techniques.
C. explain the proper procedure for cabinet drawing techniques.
D. explain the proper procedure for cavalier drawing techniques.

IV. The student will understand and apply perspective techniques. Specifically the student will be able to:

A. differentiate among different types of perspective projections.
B. select the proper technique for the one point perspective.
C. select the proper technique for the two point perspective.
D. select the proper technique for the three point perspective.

V. The student will understand and apply the proper techniques for production illustrations. Specifically the student will be able to:

A. select the appropriate technique for assembly drawings.
B. select the appropriate technique for advertising illustrations.
C. explain the technique for piping diagrams.
D. select the appropriate technique for architectural presentations.
E. select the appropriate technique for patent drawings.

Unit: DEVELOPMENTS AND INTERSECTIONS

Outline of Unit

I. Introduction to Developments and Intersections

II. Methods of Surface Development

III. Intersections of Figures

IV. Manufacturing Methods

Goal Statement

The draftsman selects from a variety of methods of developments as they apply to practical shapes. He utilizes these developments and intersections accurately so units can be fabricated. He is familiar with the fabricating machines and methods used by industry and is keenly aware of many problems which can be eliminated through accurate work on the part of the draftsman.

General and Specific Objectives

I. The student will understand the basic considerations of developments and intersections. Specifically the student will be able to:

   A. identify a development as a surface that can be laid out on a plane.
   B. identify a development of a prism or cylinder as a parallel line development.
   C. identify a development of a cone or pyramid as a radial line development.
   D. identify a transition piece as a piece that connects two different shaped, different sized, or skewed position openings.
   E. define triangulation as a method of dividing a surface into a number of triangles, and transferring them to the development.

II. The student will demonstrate the ability to produce developments according to standard technique. Specifically the student will be able to:

   A. lay out and make a parallel line development of a cylinder, given the diameter and length.
   B. lay out and make a parallel line development of a prism, given a side and length.
   C. lay out and make a radial line development of a cone, given the diameter and altitude.
   D. lay out and make a radial line development of a pyramid, given the the base and altitude.
   E. develop a transition piece (square to round) given the diameter of round, side of square, and height of piece.
   F. draw all developments with the inside face up.
   G. make allowances for forming and fastening methods.
   H. place the proper dimensions on the development.

III. The student will appreciate the value of developments as a manufacturing method. Specifically the student will be able to:

A. list methods of fastening metals in developments.
B. given a list of various materials, identify them as developable.
C. given a list of various sheet metal working machines, identify the use of each.
D. identify sheet metal gauge thicknesses.
E. lay out the pattern and construct cones and frustrums to a model funnel.
F. lay out the pattern and construct a 90° elbow in a round and in a rectangular duct.

IV. The student will demonstrate the ability to find the intersection of solids. Specifically the student will be able to:

A. find the line of intersection between two square prisms at perpendiculars to each other, develop the pattern and transfer the intersection to the stretchout.
B. find the intersections and developments of two prisms oblique to each other.
C. find the intersections and developments of two cylinders perpendicular to each other.
D. find the intersections and developments of two cylinders oblique to each other.
E. find the intersections and developments of a prism and a cone.

V. The student will appreciate the use of plane and descriptive geometry solutions as methods of getting the correct solution. Specifically the student will be able to:

A. identify a stretchout of a cylinder as the circumference of the given cylinder.
B. prove the true length of the pattern of a pyramid as the hypotenuse of a right triangle, whose altitude and base are given.
C. find the sector angle of a given cone as a fractional part of a circle.
D. Explain the principles of bend allowance.

Unit: CHARTS AND GRAPHS

Outline of Unit

I. Orientation to Drafting

A. Kinds of data
B. Methods of presentation

II. Types of Charts

A. Pie
B. Percentage
C. Bar
D. Pictorial
E. Process

III. Design and Layout

A. Procedures
B. Calculations
C. Data

Goal Statement

The draftsman uses the appropriate graphs and/or charts to convey all the information required by the problem. The draftsman must apply the proper graphic techniques to satisfy the job requirements.

General and Specific Objectives

I. The student will appreciate the wide use of graphs and charts. Specifically the student will be able to:

A. describe the type of data conveyed by the use of charts and graphs.
B. explain the use of charts and graphs.
C. describe the different types of charts and graphs.

II. The student will understand and apply the different types of charts and graphs. Specifically the student will be able to:

A. identify and describe a bar chart.
B. identify and describe a pie chart.
C. identify and describe a line chart.
D. identify and describe a flow chart.

III. The student will be able to apply the appropriate layout procedure. Specifically the student will be able to:

A. select the proper form of presentation of data.
B. select the proper rendering technique.

Unit: CAMS AND GEARS

Outline of Unit

I. Types of Cams

- A. Plate or disc cam
- B. Terminology--components
- C. Displacement diagram
- D. Classification--end or groove
- E. Development of cylindrical surface

II. Cam Followers

- A. Types
- B. Terminology

III. Cam Motion--Displacement diagram

IV. Layout of Cam Profiles

V. Types of Gears

- A. Classification
  - 1. Spur
  - 2. Bevel
  - 3. Worm and helical
- B. General purposes of gears

VI. Gear Terms and Formulas

- A. Nomenclature
- B. Formulas
- C. Calculations

VII. Procedures Used in Drawing Gears

Goal Statement

As the result of studying this unit, the draftsman will be able to draw the different types of cams and gears, as well as identifying the correct terminology for each machine element.

General and Specific Objectives

I. The student will apply correct terminology to each cam and gear. Specifically the student will be able to:

- A. identify gear tooth nomenclature.
- B. identify cam nomenclature.
- C. match a list of gear terms with the correct definitions.

II. The student will demonstrate the use of the Machinist's Handbook. Specifically the student will be able to:

A. look up different formulas for specific gear requirements.
B. find the natural trigonometric functions.
C. use the American Standard gear tooth specifications.
D. find the angular setting required for cutting a cam.

III. The student will appreciate the relationship between mathematics and cam and gear construction. Specifically the student will be able to:

A. calculate the various formulas for each gear.
B. match a list of gear formulas with gear terms.
C. determine the ratios of one gear to another.

IV. The student will understand the importance of different types and functions of cams and gears. Specifically the student will be able to:

A. identify different types of gears.
B. identify different types of cams.
C. explain what each gear is used for.
D. explain what each cam is used for.

Unit: STRUCTURAL DRAWING

Outline of Unit

I. Types of Structures

II. Materials of Structures

III. Sub-structures

IV. Detailing Structures

Goal Statement

The structural draftsman transmits the design information to fabrication and assembly working drawings using the proper symbols and conventions.

General and Specific Objectives

I. The student will understand the basic terms and principles of structural design. Specifically the student will be able to:

A. identify the main structural parts of a building, bridge, tank or tower.
B. define the term load.
C. classify a load as either a "dead" or a "live" load.
D. identify a uniformly distributed load and concentrated load.
E. define the following kinds of stress: tensile, compressive, shear, bending, and twisting.
F. classify the type of structure represented on a drawing.
G. list the purpose of each structural member.

II. The student will develop a working knowledge of materials and methods of structural systems. Specifically the student will be able to:

A. designate reinforcing rods.
B. designate lumber sizes.
C. designate structural steel shapes.
D. list the advantages and disadvantages of using concrete in a structural system.

III. The student will apply standard techniques to structural detailing and layouts. Specifically the student will be able to:

A. identify a specific drawing as a framing plan.
B. place the correct material notation on a structural drawing.
C. indicate a joist on a plan.
D. indicate bridging on a plan.
E. correctly record a dimension on a structural drawing.

IV. The student will demonstrate the ability to produce detail working drawings from engineering sketches and framing plans. Specifically the student will be able to:

A. detail a lally column.
B. detail a structural beam.
C. detail lintels.
D. detail a truss.
E. detail footers, walls, and floors.

Unit: RESIDENTIAL ARCHITECTURAL DRAFTING

Outline of Unit

I. Introduction to Architectural Drafting

II. Floor Plan Layout

III. Drawing Elevations

IV. Architectural Dimensioning

V. Basement and Foundation Plans

VI. Architectural Wall Sections

Goal Statement

The draftsman understands site selection characteristics and standard drawing conventions in developing residential working drawings of plans, elevations, sections, and details.

General and Specific Objectives

I. The student will understand the primary considerations in selecting a building site. Specifically the student will be able to:

   A. relate the slope of the lot with the architectural style.
   B. determine the reasons for checking building codes when selecting a building site.
   C. relate the shape of the building lot with the style of the house.
   D. compare the purpose of a building code with the purpose of the deed restrictions.
   E. explain how zoning regulations control noise pollution.
   F. differentiate between zoning ordinances and deed restrictions.
   G. differentiate between easements and zoning ordinances.
   H. evaluate utility provisions.

II. The student will analyze floor planning characteristics which influence the interior design of a residence. Specifically the student will be able to:

   A. identify minimum room sizes.
   B. evaluate room locations for plumbing efficiency.
   C. select room orientation in relation to solar load.
   D. select room orientation in relation to prevailing wind directions.
   E. compare the advantages of building a two story residence to building a single story residence of the same square footage.
   F. determine wall space required for an average sized kitchen.
   G. select door sizes for given structures.
   H. select window sizes for given structures.
   I. relate the concept of open planning to interior design.

J. identify the work triangle in a kitchen design.
K. apply the correct principles for door location, producing a good traffic pattern for a room layout.

III. The student will analyze the styling factors that influence the exterior design of a house. Specifically the student will be able to:

A. differentiate between the various roof styles.
B. analyze the effect of adding glass to exterior walls.
C. differentiate between the various window styles.
D. select materials for exterior styling.
E. differentiate between symmetrical and asymmetrical composition in exterior design.
F. analyze the effect climatic conditions have on roof pitch selection.
G. match styling characteristics with residential architectural styles.
H. explain the economic reason for the evolution of the bungalow style from the Victorian house style.
I. analyze the combinations which make up a roof style.

IV. The student will apply standard architectural drafting conventions in drawing floor plans. Specifically the student will be able to:

A. select the scale for drawing plans.
B. identify the symbols for materials.
C. indicate arched doorways in the plan.
D. indicate wall cabinets in the plan.
E. indicate door types in the plan.
F. indicate stairs in the plan.
G. allow for door framing on intersecting walls.
H. select window size for indication in the plan.
I. apply proper contrast of lines.
J. use an architectural floor plan template.
K. indicate door swings.
L. identify cabinet and appliance sizes.
M. understand what type of information is to be included in the specifications.
N. determine wall sizes.

V. The student will apply architectural dimensioning to working drawings. Specifically the student will be able to:

A. dimension door and window locations in wood frame construction.
B. dimension door and window locations in masonry construction.
C. locate interior partitions in relation to outside frame wall.
D. locate window schedule symbols.
E. write dimension numbers.
F. locate dimension numbers.
G. locate dimensions in proper sequence.
H. dimension windows above finish floor.
I. identify the characteristic difference between architectural lettering and standard Gothic lettering.
J. match the alphabet of lines to its function in architectural drafting.

VI. The student will apply standard architectural drafting conventions in drawing elevations. Specifically the student will be able to:

A. draw material symbols in an elevation.
B. designate hinged window pivot direction in an elevation.
C. indicate the footer in an elevation.
D. identify the two drawings most useful in projecting elevations.
E. select the scale for drawing elevations.
F. relate the principles of orthographic projection with the drawing of elevations.
G. indicate a window well.
H. label elevations.
I. apply line technique in drawing elevations.
J. identify window framing terminology.

VII. The student will understand standard architectural drafting conventions in drawing residential foundation plans. Specifically the student will be able to:

A. differentiate between a frost line and a grade line.
B. determine footing thickness when given foundation wall thickness.
C. determine height of grade in crawl space in relation to exterior grade line.
D. indicate girder for first floor joists.
E. draw footer outline around foundation walls.
F. identify the purpose of lally columns.
G. locate the girder.

VIII. The student will apply standard architectural drafting conventions in drawing wall sections. Specifically the student will be able to:

A. identify the parts of a frame wall section.
B. differentiate between nominal size and actual size.
C. differentiate between platform framing construction and balloon framing construction.
D. identify the purpose of anchor bolts.
E. identify the purpose of pargeting.
F. explain the purpose of expansion joists.
G. identify the standard center to center spacing of joists.
H. identify the standard center to center spacing of studs.
I. compare the advantages of the use of trusses versus the use of rafters.
J. indicate the minimal crawl space.
K. recognize how wood members are protected from termites.

IX. The student will understand common architectural mathematical calculations. Specifically the student will be able to:

A. calculate board feet in given quantities of lumber.
B. calculate the square footage of a given floor plan.
C. calculate cubic yardage.
D. calculate squares of rooting material.
E. convert roof pitch symbol to degree slope.
F. determine the total run of a stair when given total rise and tread/riser ratio.

X. The student will demonstrate an understanding of a stair layout. Specifically the student will be able to:

A. identify the parts of a stair.
B. select a proper tread/riser ratio.
C. indicate the minimal head clearance for basement stairs.
D. indicate the minimal handrail height.
E. identify the basic stair dimensioning terminology.
F. identify standard nosing dimension.

Unit: ELECTRICAL DRAFTING

Outline of Unit

I. Introduction

II. Circuits

III. Symbols

IV. Electrical Drawings

Goal Statement

The draftsman uses the appropriate symbols and drafting techniques to convey all the information required to produce working drawings.

General and Specific Objectives

I. The student will understand the common electrical terms. Specifically the student will be able to:

A. identify a schematic diagram.
B. identify a wiring diagram.
C. classify a specific drawing as an electrical layout.
D. give the purpose of a block diagram.
E. list the common conductors of electricity.
F. differentiate between circuits.
G. define units used in measuring electrical quantities.
H. list sources of electromotive force.
I. designate an interconnection diagram.

II. The student will understand and apply various electrical circuits. Specifically the student will be able to:

A. identify the various types of circuits.
B. draw circuits from input to output, source to load, in order of functional sequence.
C. lay out a schematic diagram using proper techniques.
D. relate the schematic symbol to the actual fixture.
E. relate various symbols to specific diagrams.

III. The student will understand and apply electrical symbols. Specifically the student will be able to:

A. select from a given list the applicable symbol to represent electrical unit.
B. differentiate between line connections.
C. relate specific meaning to the use of lines on the diagram.
D. draw size of symbol proportional to drawing size.
E. use the standard technique in terminal and contact identification.
F. relate the bill of materials to the schematic diagram.
G. use the standard symbols in a wiring layout.

IV. The student will apply the various practices and economics of electrical drafting to several separate and distinct areas of drafting. Specifically the student will be able to:

A. list reasons for making electrical diagrams.
B. name the major characteristics a wiring system should have.
C. describe the basic reasons for the National Electrical Code.
D. relate the need for various wire sizes.
E. identify various types of special purpose outlets.

Unit: PIPE DRAWINGS

Outline of Unit

I. Kinds of Pipes

A. Tubing
B. Special pipes

II. Joints and Fittings

III. Valves

IV. Piping Drawings

Goal Statement

The draftsman uses standard symbols and conventions to convey piping information in the form of working drawings.

General and Specific Objectives

I. The student will apply the correct terminology to the different kinds of pipes. Specifically the student will be able to:

A. distinguish between the various materials used for pipes.
B. distinguish between the various sizes of pipes.
C. identify the uses of the different kinds of pipes.

II. The student will have a working knowledge of the different types of joints and fittings. Specifically the student will be able to:

A. given a list of common fittings, determine their definitions.
B. identify the various methods of connecting one pipe to another.
C. identify tube joints.

III. The student will understand the use of valves in piping drawings. Specifically the student will be able to:

A. explain the purpose of a check valve.
B. explain the purposes of a globe valve.
C. explain the purposes of a gate valve.

IV. The student will apply the standard conventions and practices in making piping drawings Specifically the student will be able to:

A. identify piping symbols.
B. dimension pipe drawings.
C. describe the systems of making pipe drawings.
D. draw pipe arrangements.

Unit: HEATING, VENTILATING AND AIR CONDITIONING

Outline of Unit

I. Introduction to Heating, Ventilating and Air Conditioning

II. Types of Systems

III. Heat Loss Computation

IV. HV and AC Standard Drafting Procedures

Goal Statement

The draftsman applies the standard conventions in representing engineering designs which are usually in the form of a sketch and written calculated data. It is the duty of the draftsman to change the sketch and written information to a working drawing which is returned to the designer for checking and approval.

General and Specific Objectives

I. The student will understand the basic principles of heating. Specifically the student will be able to:

   A. define BTU (British Thermal Unit).
   B. explain how heat is transferred.
   C. differentiate between convection and conduction.
   D. differentiate between convection and radiation.
   E. define heat loss.

II. The student will understand the basic principles of ventilation. Specifically the student will be able to:

   A. determine areas where an exhaust system is required.
   B. differentiate between infiltration and exhaust.
   C. identify the meaning of CFM (cubic feet per minute).
   D. differentiate between exhaust air and return air.
   E. calculate the volume of a given area.

III. The student will understand the principles of air conditioning. Specifically the student will be able to:

   A. differentiate between heat loss and heat gain.
   B. explain the basic principles of the refrigeration cycle.
   C. explain how the air filter relates to the forced air system.
   D. explain how air movement is provided and directed.
   E. differentiate between humidification and dehumidification.

IV. The student will understand how heat loss is computed. Specifically the student will be able to:

A. determine the design temperature difference.
B. define the "U" factor.
C. identify the formula for computing heat loss.
D. given a specific area, compute heat loss.
E. differentiate between thermal resistance and the "U" factor.
F. relate CFM to air quantity measurement.
G. identify good heat transfer coefficients.
H. recognize the purpose of the Ashrae Guide.

V. The student will understand the layout of a forced air heating system. Specifically the student will be able to:

A. identify the advantages of a forced air system over an electric heating cable system.
B. identify the characteristics of a forced air system.
C. recognize the purposes of installing duct liners.
D. identify HV and AC symbols (heating-ventilation and air conditioning).
E. identify types of forced air duct layout systems.

VI. The student will understand the layout of a hot water heating system. Specifically the student will be able to:

A. relate GPM (gallons per minute) with water quantity measurement.
B. differentiate between a direct return hot water piping system and a reverse return hot water piping system.
C. explain the purpose of a compression tank.
D. identify piping symbols.
E. understand the purpose of expansion elbows.

Unit: CIVIL DRAFTING

Outline of Unit

I. Areas of Civil Drafting

II. Related Equipment

III. Types of Drawings

IV. Related Employment Fields

V. Collecting Field Data (Surveying)

Goal Statement

The draftsman properly restates information from field notes to finished drawings. He represents the data according to the specific type of drawing required.

General and Specific Objectives

I. The student will recognize different types of civil drawings. Specifically the student will be able to:

A. identify cadastral maps.
B. identify the characteristics of an individual plot survey.
C. interpret information from a subdivision plot.
D. differentiate between various engineering maps.
E. define the characteristics of quadrangle maps.

II. The student will become familiar with the various instruments used to compile field data. Specifically the student will be able to:

A. identify the various instruments for triangulations and traverse plottings.
B. relate the compiling of field data to the development of a drawing.
C. develop a contour data notebook with proper instrumentation.
D. develop correct graphic forms by various plotting methods.

III. The student will understand how to develop, using proper symbols, a sample of the various types of drawings used in civil drafting. Specifically the student will be able to:

A. develop an open traverse.
B. construct a closed traverse.
C. develop an individual plot survey.
D. interpret a subdivision plot.
E. develop a cadastral map.
F. solve a contour and profile problem.

IV. The student will realize the employment opportunities related to civil drafting. Specifically the student will be able to:

A. list the types of civil drawings used in the construction trades.
B. identify related fields of employment that would use civil drafting knowledge.
C. relate civil drafting knowledge to consumer related needs.
D. identify advancement opportunities in the field.

V. The student will understand the methods of collecting various field data. Specifically the student will be able to:

A. develop a closed traverse by using either a spirit level or transit.
B. identify points of elevation from a known bench mark by the leveling process.
C. locate property markers for a given plot by proper surveying techniques.
D. develop a full plot survey by means of the plane-table method and the alidade method.
E. shoot points of elevation with a transit.
F. locate obscure points by tangent offset plotting.
G. compute distance by use of stadia surveying techniques.